

- (57) A Hooke's universal joint, wherein at least part of the outer surface of each bearing bush 7 or the inner surface of each of the bores 10 in the yokes in which the

bearing bushes are received is provided with outwardly extending grooves. The grooves may be of increasing depth with increasing distance from the axis of rotation of the respective joint yoke. The grooves permit elastic deformation to equalise the loading on the needle rollers between the journal 9 and the bush 7.

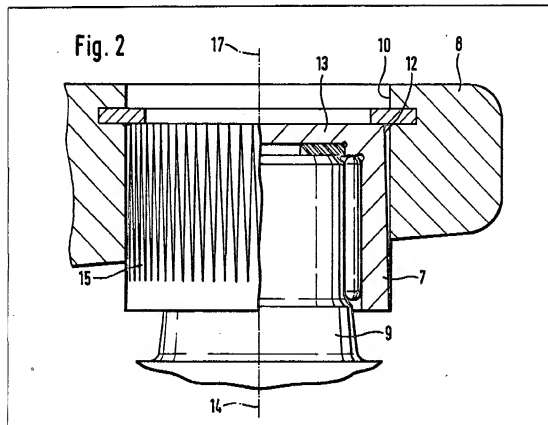
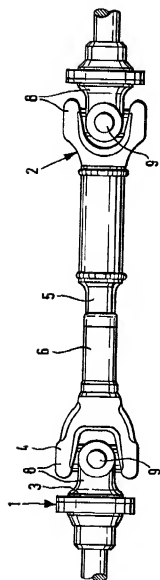


Fig. 1



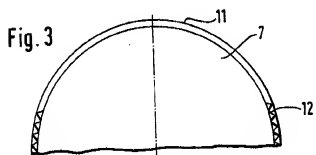
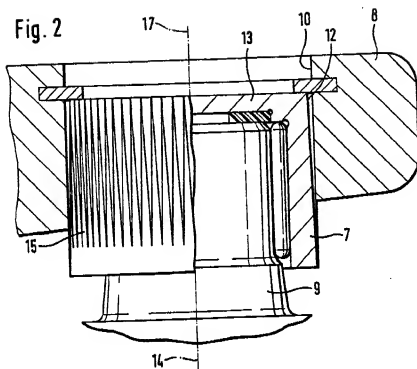


Fig. 4

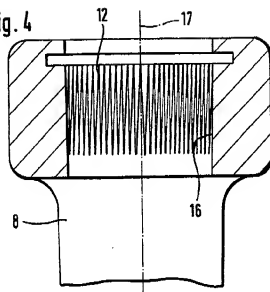
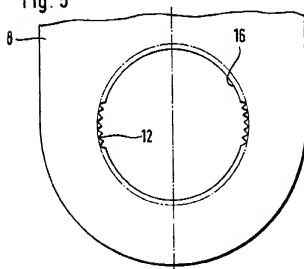


Fig. 5



## SPECIFICATION

## Hookes universal joints

- 5 This invention relates to a Hookes universal joint, comprising two yokes each having spaced limbs with opposed aligned bores, and a cross member having journals received in the bores of the yoke limbs with the intermediary of bearing bushes, to connect the yokes for universal pivotal movement.

- 10 One problem which arises with Hookes universal joints is that there is a tendency for uneven loading of the bearings supporting the journals of the cross member during torque transmission. In a joint with needle rollers between the bearing bushes and journals, the load may not be evenly distributed along their lengths. It has been proposed, in German Patent specification 1122781, that the bearing surfaces of the journals or bushes can be tapered so that under conditions of slight distortion during torque transmission the needle rollers are evenly loaded. Whilst this is effective, it has the disadvantage that a conical surface is difficult to produce on the journals or bushes.

- It has also been proposed, in British Patent specification 1580718, that the bearing surfaces of the journals or bushes can be ground to a slightly elliptical profile, so that the loading is shared between a greater number of needle rollers than would be the case otherwise. However, it is again difficult to manufacture such bearing surfaces.

- It is the object of the present invention to provide a more economical way of achieving optimum utilisation of the bearing capacity of the joint.

- 40 According to the invention, we provide a Hookes universal joint wherein at least part of the outer surface of each bearing bush or the inner surface of each bore is provided with grooves which extend outwardly, having regard to the axis of rotation of the respective joint yoke.

- The advantage of such a design is that by the provision of the grooves inside each yoke bore or on the exterior of each bearing bush, the possibility of elastic deformation of the bearing bush is increased, enabling more even loading of the bearings during any tendency to slight distortion when transmitting torque. In addition, the grooves facilitate installation of the bearing bushes in the yokes, by acting in a manner analogous to a lead-in chamfer. The grooves may be provided by knurling.

- The grooves may be of increasing depth as the radial distance from the axis of rotation of the respective joint yoke increases. This assists equalisation of loading over the length of individual needle rollers, which in turn prolongs service life under maximum load.

- This effect is provided whether the grooves 65 are in the external surface of the bearing

bushes or the inner surface of the bores in the yokes.

- The grooves may be provided over part only of the circumference of each bearing bush or bore, in two diametrically opposite regions in the direction of rotation of the joints. Such regions may cover at least double the maximum angle of articulation of the joint.

- Alternatively the grooves may extend over 75 the entire circumference of each bearing bush or bore.

- The invention will now be described by way of example with reference to the accompanying drawings, of which

- 80 *Figure 1* is a drive shaft having Hookes universal joints

- Figure 2* is a section through one of the bearing assemblies of a universal joint

- Figure 3* is an end view of part of the 85 assembly of Fig. 2.

- Figure 4* is a section through part of a yoke of a Hookes joint according to the invention

- Figure 5* is a plan view of the joint yoke of Fig. 4.

- 90 Referring firstly to Fig. 1, there is shown a drive shaft comprising a first shaft portion 1 connected by a flange 3 to one yoke of a Hookes universal joint with another yoke 4. The yoke 4 is connected to a shaft portion 8 which in turn is connected via a spline assembly 5 to a further Hookes joint 2 and thence to a further shaft portion. The Hookes universal joints each comprise spaced limbs 8 of each yoke, having opposed aligned bores, and 100 a cross member 9 having journals received in the bores of the yoke limbs.

- Referring now to Figs. 2 and 3 of the drawings, this shows one of the yoke limbs 8 and its bore 10, in which is received a bearing bush 7 which supports the journal 9 of the joint with the intermediary of needle roller bearings. The bearing bush is a cup, having a closed end 13. It is retained in the bore by a circlip engaged in an annular groove.

- 110 The outer surface 11 of the bearing bush is provided with grooves 12 which are parallel to the axis of the bush, i.e. they extend outwardly with regard to the axis of rotation of the joint yoke as a whole. The grooves 12 are of increasing depth as they extend outwardly, so that their bases lie on a frusto conical surface.

- As shown in Fig. 2, the grooves 12 extend around the entire circumference of the bearing 120 bush. As an alternative, they could extend around part only of the circumference, as shown in Fig. 3. In this case, the amount of the circumference of the bearing bush over which the grooves extend would be at least twice the maximum angle of articulation of the joint. The grooved area of the bearing bush would contain plane 14 defined by the centre line 17 of the bore in the yoke when rotating in use.

- 130 Referring now to Fig. 4 of the drawings,

this shows a yoke limb 8 whose bore 16 is provided with outwardly extending grooves 12. These grooves are of increasing depth with increasing distance from the axis of rotation of the yoke. Such a yoke would be used with bearing bushes whose external surface is not grooved. This arrangement, as is the case for that in which the external surface of the bearing bushes is grooved, permits slight elastic deformation of the bush under torque loading, thereby rendering more even the loading on the needle rollers to make optimum use of the theoretical capacity of the bearing.

In Fig. 5, there is shown an arrangement in which the grooves 12 in the internal surface of the yoke bore are provided over part only of the circumference thereof. As for Fig. 3, the circumferential extent of the grooves would be equal to at least twice the maximum articulation angle of the joint.

#### CLAIMS

1. A Hookes universal joint comprising two yokes each having spaced limbs with opposed aligned bores, and a cross member having journals received in bearing bushes in the bores of the yoke limbs, wherein at least part of the outer surface of each bearing bush or the inner surface of each bore is provided with grooves extending outwardly having regard to the axis of rotation of the respective joint yoke.

2. A universal joint according to Claim 1 wherein said grooves are of increasing depth with increasing distance from the axis of rotation of the respective joint yoke.

3. A universal joint according to Claim 1 or Claim 2 wherein said grooves extend over part only of the circumference of each bearing bush or bore, over a region at least twice the maximum articulation angle of the joint.

4. A universal joint according to Claim 1 or Claim 2 wherein said grooves extend over the entire circumference of each bearing bush or bore.

5. A universal joint substantially as hereinbefore described with reference to Figs. 2 and 3, or Figs. 4 and 5 of the accompanying drawings.